

negative electrode is composed of the material including a binder and an active material wherein the binder includes a mixture of a fluorine polymer and an aromatic vinyl-conjugate diene polymer and wherein the active material includes a carbonaceous material. The binder includes from about 2 weight percent to about 15 weight percent of the total weight of the negative electrode wherein the mixture ratio of the fluorine polymer to the aromatic vinyl-conjugate diene polymer ranges from about 1 to about 99.

Applicants have uniquely discovered that the specific material makeup in combination with the structural features of the claimed invention can provide a nonaqueous electrolyte secondary battery which is capable of preventing an excessive rise in the temperature even if an unexpected external short circuit occurs during use. Further, the present invention can provide a nonaqueous electrolyte secondary battery that has excellent cycle characteristics even under a heavy load. Moreover, the wound-type structure of the claimed nonaqueous electrolyte secondary battery allows the quantity of active material per unit of content to be increased. In this regard, the energy per unit content of the claimed invention effectively increases without excessive increase in temperature during use.

More specifically, the claimed invention includes, in part, a negative electrode that has an active material including a carbonaceous material and a binder that includes a mixture of a fluorine polymer and an aromatic vinyl-conjugate diene polymer in specified amounts. In this regard, the nonaqueous secondary battery can display a lower short circuit temperature, thus preventing an excessive rise in temperature upon occurrence of an external short circuit. This overcomes problems typically associated with secondary batteries that utilize a carbonaceous material as an active material with respect to the negative electrode. See, Specification, pages 2 and 3.

Applicants have conducted a number of experiments that demonstrate the beneficial effects of the claimed invention. For example, as shown in Table 1, the test batteries (Samples 3-7) that included a negative electrode with a 10 wt% binder content of a mixture of a fluorine polymer and an aromatic vinyl-conjugate diene polymer in accordance with an embodiment of the present invention displayed higher initial capacities and lower short circuit temperatures as compared to test batteries (Samples 1 and 2) that included a binder composed of only PVDF or SBR. Further, as shown in Table 2, the test batteries (Sample 3 and Samples 9 to 11) with a 2 wt% to 15 wt% binder mixture in accordance with an embodiment of the present invention had

higher initial capacities of 1244 mAh to 1349 mAh as compared to an initial capacity of 673 mAh for a battery with a 1 wt% binder content (Sample 8). Further, the short circuit temperatures were as low as 58°C to 69°C for the test batteries of Sample 3 and Sample 9-11 (binder content 2 wt% to 15 wt%).

BS ( With respect to the obviousness rejection of claims 7-9 and 12-16 in view of *Suzuki* and *Koichiro*, the Patent Office primarily relies on *Suzuki* and thus relies on *Koichiro* to remedy the deficiencies of *Suzuki*. As even admitted by the Patent Office, *Suzuki* fails to disclose the binder features as required by the claimed invention. As previously discussed, Applicants have demonstrated that the binder features can act, for example, to prevent an excessive rise in temperature upon short circuiting. Therefore, *Suzuki* is clearly deficient with respect to the claimed invention.

does not matter ( Further, Applicants do not believe that the Patent Office can rely solely on *Koichiro* to remedy the deficiencies of *Suzuki*. Indeed, the Patent Office' appears to admit (See, Office Action dated December 18, 2002, p. 7) that *Koichiro* fails to disclose a nonaqueous secondary battery that employs a carbonaceous material as an active material for the negative electrode as required by the claimed invention. Thus, *Koichiro*, like *Suzuki*, is clearly deficient with respect to a nonaqueous secondary battery that includes, in part, a negative electrode with an active carbon material and specified binder features as required by the claimed invention.

FP ( Applicants have demonstrated that the claimed nonaqueous secondary battery overcomes problems typically associated with nonaqueous secondary batteries that employ a carbonaceous active material as previously discussed. Nowhere does *Koichiro* or *Suzuki* disclose or suggest such unique and unexpected benefits as Applicants have demonstrated. Why then would one skilled in the art be inclined to combine *Koichiro* and *Suzuki*, let alone modify same, to arrive at the claimed invention. What the Patent Office clearly has done is to apply hindsight reasoning to justify this rejection. Of course, this is clearly improper. For at least these reasons, Applicants believe that *Suzuki*, even if combinable with *Koichiro*, fails to render obvious the claimed invention.

( With respect to the obviousness rejection of claims 7-9, 12 and 14-16 in view of *Koichiro* and *Yamashita*, clearly *Koichiro* is deficient with respect to the claimed invention as previously discussed. Again, nowhere does *Koichiro* disclose or suggest a nonaqueous secondary battery that includes, in part, a negative electrode that combines an active carbonaceous material with a

holder in specified amounts as required by the claimed invention. This can act, for example, to prevent an excessive rise in temperature upon short circuiting and thus can overcome problems typically associated with nonaqueous secondary batteries that employ a carbonaceous active material. Indeed, the Patent Office even appears to admit that *Koichiro* fails to disclose a nonaqueous secondary battery that employs a carbonaceous active material as previously discussed. Therefore, *Koichiro* is clearly deficient with respect to the claimed invention.

Further, the Patent Office cannot solely rely on *Yamashita* to remedy the deficiencies of *Koichiro*. In this regard, *Yamashita* is merely relied on for its alleged teachings regarding applying an active material to both sides of a current collector. See, Office Action dated December 18, 2002, p. 7. In view of same, Applicants do not believe that one skilled in the art, viewing *Yamashita*, would be inclined to modify *Koichiro* to arrive at the claimed invention. For at least these reasons, Applicants believe that *Koichiro*, alone or in combination with *Yamashita*, fail to render obvious the claimed invention.

Claim 13 is also rejected in view of *Koichiro* and *Abe*. Claim 13 depends from Claim 7 and thus incorporates each of the features of Claim 7 as a matter of law. As previously discussed, Applicants believe that *Koichiro* is clearly deficient with respect to the subject matter as defined in Claim 7.

Further, Applicants do not believe that the Patent Office can rely solely on *Abe* to remedy the deficiencies of the claimed invention. Indeed, the Patent Office merely relies on *Abe* for its alleged teachings regarding a negative electrode mix that is high in viscosity. See, Office Action dated December 18, 2002, p. 8. In view of same, Applicants do not believe that one skilled in the art would be inclined to modify *Koichiro* in view of *Abe* to arrive at the claimed invention. For at least these reasons, Applicants do not believe that *Koichiro*, even if combinable with *Abe*, render obvious the claimed invention.

Accordingly, Applicants respectfully request that the obviousness rejections be withdrawn.


Appl. No. 09/284,222

For the foregoing reasons, Applicants believe that the present application is in condition for allowance and earnestly solicit reconsideration of same.

Respectfully submitted,

BELL, BOYD & LLOYD LLC

BY

  
Thomas C. Basso  
Reg. No. 46,541  
P.O. Box 1135  
Chicago, Illinois 60690-1135  
Phone: (312) 807-4310